THE DOCTOR, HIS PATIENT, AND THE ENVIRONMENT

Lawrence E. Hinkle, Jr., M.D.

FROM the time of Claude Bernard to the present day, physicians have been concerned with the problems of fluid homeostasis, of energy metabolism, of growth, of inflammation, and of repair that go on within the human body. Our concern has taught us a great deal about the environment in which our cells live and about the structure and function of the component organizations that make up the man; but, we have learned less about the behavior of man himself: about how man interacts with his environment, and about how this affects his health. This, I may venture to say, will be a major concern of the next 100 years of medicine.

Life, as we understand it today, is dependent upon the maintenance of a dynamic steady state of a complex hierarchy of biologic organizations which make up the living organism. It implies a constant interaction between organism and environment.

For the simplest organism, life means interaction with only the most immediate environment—with the here and now. The higher organisms, of course, are under no such restraint. They have an elaborate apparatus of external sensors connected to a nervous system that can integrate complex patterns of information, recognize them, compare them to an extensive memory, associate them with other patterns, and then elaborate complex, integrated patterns of biologically meaningful activity. This enables them to deal with a far more extensive environment, much of which is at a distance from them in time as well as in space. They continuously interact with objects that are at a great distance from them, and with events and situations that will probably occur in the future, as well as those which have already occurred in the past. They react not just to material objects, but also to the relationships between them. They also display the phenomenon of learning, and thus can react to new events and situations on the basis of those which they have encountered before.

For civilized man, the most complex organism, by far the greater part of the environment is that which is at a distance from him in space and time—even if only by a few millimeters or milliseconds. Only a very few of the interactions between a man and his environment take the form of a direct, quantitative interchange of energy. He does experience some discomfort and damage from sunburn, frostbite, or an occasional encounter with a wayward taxicab. He does, increasingly, encounter the disorganizing effect of the radiation, much of which results from his own activities. But these are, truthfully, a numerically small part of his interactions with the world around him.

Man's interactions with bacteria, drugs, toxic materials, and allergens are more numerous, and they are also more complex. These agents do, in a sense, impinge upon him and invade him, but his reaction to them is based on their configuration rather than their energy content. His interaction with each is, technically, a communicative transaction, even though it is not primarily mediated by the neural apparatus. Each evokes a reaction which is to a certain extent "special" to the impinging agent and based upon past experience with it.

However, interactions with such agents are numerically no more frequent than the constant interaction between the man and that vast environment which does not impinge upon him at all, except in the form of patterns of minute amounts of energy that fall upon his sensory apparatus. As human culture has grown exponentially over the past several hundred generations and has exploded during the past few, this part of the human environment has become vastly more extensive and complex. The communicative tools of the culture bring to us, in a moment, information about events in all parts of the globe, so that when John Glenn is about to be fired into orbit, or President Kennedy is about to announce his decision on Cuba, millions can simultaneously elaborate their epinephrine as the event occurs. Men who view these events anticipate the effects on their lives and activities, not just in terms of days or weeks, but in terms of years or decades. They base their evaluations on bodies of experience that extend equally far into the past.

From the point of view of the human biologist, it is convenient to divide the elaborate and complex environment of man into two categories. One of these might be called the extensive environment, and the other the personal environment.

The extensive environment is not the immediate concern of the physician in dealing with his patient. It is of very important concern to medicine, but it lies in the domain of public health, since it influences the health of large groups of people, and a life setting which affects them all. Matters pertaining to this extensive environment therefore are not the immediate concern of this discussion. Yet, I must remark in passing that if we wish to minimize the deleterious effects in our patients of inhaling cigarette smoke, it becomes essential to understand the social process which made cigarette smoking a fashionable habit in the first part of the twentieth century. Alcoholism and the consumption of tranquilizing medications raise similar problems. The matter of automobile accidents calls increasingly for the help of the experimental psychologist, if we are to understand in what manner we can put a man with 15 mile-per-hour reflexes into a vehicle which travels at 70 miles per hour. Indeed, such matters as the rapid extension of human population, the alarming limitations on our water resources, and the steady increase in nuclear fallout are matters which I do not believe we shall solve without calling upon the help of the political scientists.

When a physician deals with his patient, he is concerned with the interaction between a man and his personal environment. Much of this environment is at a distance from the man; it is personal only because it is unique to him. A very large proportion of his interactions with it are mediated by way of his central nervous system; no small part of them involves his gross behavior. For example, socially sanctioned activities which affect health are often expressed as gross behavior. Smoking cigarettes, drinking alcohol, and driving rapidly are all socially sanctioned activities which may have unhealthy consequences for the person.

On a more subtle level, many facets of daily life which influence health are mediated by gross behavior, elaborated in response to the personal environment: the fact that a college student stays up late at night to study, taking amphetamine, and not getting enough sleep is determined not only by his relationship to his college, but also by his relationship to his parents, who may be many miles away, or even dead. The fact that a businessman commutes 40 miles to and from work each day, remains at his desk until 6 P.M. or later, spends several nights a week in civic activities, and works furiously on his house and

garden all weekend, may be determined by his relation to the social and occupational groups of which he is a part, and, in fact, may be based upon a standard of values shared by a whole segment of society. Even the fact that a man is a policeman directing traffic on a metropolitan street corner, and is therefore heavily exposed to the exhausts of automobile engines, is determined by his relationship to his superiors and to his family, as well as by his own personal drives. Thus, in dealing with illness, the physician finds himself increasingly called upon to investigate the entire pattern of activity of his patient, and to understand his daily round of life, not only at the present time, but over an extended period of the past. More than this, he sees himself required to be more and more sophisticated about the various aspects of a man's ecological niche that motivate and determine his behavior.

Quite aside from gross behavior are the functional changes in internal organs and metabolic systems which occur as a part of the individual's response to his life situation. These appear to be the result of neurally integrated and biologically meaningful patterns of activity. The late Dr. Harold G. Wolff applied to them the term "adaptive reaction patterns."[1] A large body of experimental and clinical evidence, gathered over the past two decades, indicates that these activities may be mediated by any of the peripheral effector pathways (both neural and hormonal) of the nervous system.[2] These are organized within the lower centers of the brain and are elaborated in response to the higher integrative activities of this organ. They are often (but not always) accompanied by a feeling tone, or emotion, which may be expressed or unexpressed. Both the emotion and the bodily change appear to be part of the response of the organism; these two facets of response are associated, but are not necessarily related to each other in a causal manner. These reaction patterns have been regarded as adaptive, because they are qualitatively identical with patterns of organ activity which are adaptively useful in certain specific circumstances.

An illustration of such an adaptive reaction pattern is one involving the mucosa and supporting structure of the upper air passages which was described by Dr. Thomas Holmes and Dr. Wolff several years ago.[3] My colleagues and I have studied this pattern in relation to respiratory illness at the New York Hospital-Cornell Medical Center.[4,5]

The human nose is an air conditioning and protective organ, in addition to being an organ of olfaction. When exposed to irritating fumes or to dust, the vessels of its mucosa become engorged and the mucous and serous glands secrete, in large amounts. The mucosa become increasingly red and swollen, the airways are blocked, and secretion pours from the nares. The conjunctivae may become suffused, the eyes may weep, and sneezing and coughing may occur. This highly integrated pattern, involving glands, mucosa, and skeletal muscle, mediated by way of the cranial parasympathetic and the voluntary innervation of the facial and respiratory muscles, is organized at the brainstem level or higher, and, in the words of Holmes and Wolff, it has the effect of "shutting out and washing away" the noxious material which might otherwise get into the lower airways and do damage to the organism.[3]

This reaction pattern, as such, is nonspecific; that is, it can be evoked in some people by having them breathe cold air followed by warm air, and in others it is evoked by the inhalation of certain pollens. Here it is a learned reaction because a pollen does not necessarily evoke this reaction in an individual until he has had a prior experience with it. There are also a great

number of viruses which evoke this reaction when they invade the nasal mucosa; at last count, more than 70 were known to do so.[6]

The same "shutting out and washing away" reaction may also be evoked by the activity of the higher integrative centers of the nervous system in response to events or situations occurring in the distant environment. If we place a man in a situation that makes him feel "sad," his eyes may water, and his nose may become engorged and run. The same man can be placed, experimentally, in a situation that will cause his nose to become engorged and run, even though his eyes do not water and he states that he does not feel "sad." Depending upon the circumstances under which this adaptive reaction pattern is evoked, it may be a manifestation of "allergic rhinitis," "the common cold," "weeping," or "vasomotor rhinitis."

In an attempt to understand more about the relationship between such nasal adaptive reactions and the occurrence of common respiratory diseases, we studied a small ecological system, made up of 737 women who worked in two large rooms of a building on the East Side of Manhattan Island. These women were selected because they all had the same occupation and their work brought them into intimate contact with each other and with the members of the general population. Thus, we could believe that each had frequent opportunity for exposure to the many respiratory pathogens present in the community during the course of a winter. Because they were career employees, with health records going back for many years, their past health could be assessed readily.

By random methods we selected from among these women 24 who were between the ages of 20 and 40 and who had worked at this occupation for at least five years.

Having ascertained that our designated subjects were representative of the group from which they were chosen, we then observed them intensively over a six-month period, from October through March. After an initial evaluation of their health, we examined them each week and reviewed with them any symptoms and signs of illness that had arisen in the interim. We made measurements of the color, engorgement, and secretion of their nasal mucosa, and we took photographs of the nasal mucous membranes by a carefully standardized photographic procedure. Each week we obtained bacterial and viral cultures from the nose and throat. Each month we obtained a serum sample.

We observed and recorded the daily round of life of each of these women. We obtained information about her family and the place where she lived, and, by means of sociological interviews and psychological tests, we obtained information about her attitudes and customary reactions to many facets of her life.

From the Weather Bureau, we obtained the daily pollen count, estimations of the amount of particulate matter, smoke, and sulfur dioxide in the air, and a record of the respiratory illnesses prevalent in the community. From the company at which the women worked, we obtained the daily record of absence due to sickness for all of the women in the building and for all women in the city engaged in the same kind of work.

In the course of the winter, there were two major epidemics of florid respiratory illness in New York City, one in December and the other in March. Each of these epidemics was characterized by a rise in the number of episodes reported in the city of the common cold, of an influenza-like syndrome, and of acute gastroenteritis. The three syndromes occurred together on both occasions and apparently represented various facets of individual reactions to the

pathogenic agent. The two epidemics were reflected in the rate of absence due to sickness among the 737 women in our test building and were also reflected in the number of new episodes of florid respiratory illness which occurred among the women in our sample. The syndrome most frequently displayed by our women was the "common cold," but a number of them displayed a typical "acute gastroenteritis," and some had clinically typical episodes of "influenza"—as attested to by our examining physicians, who visited them at their homes.

After the epidemics had passed, it became evident that the first of them had been caused by the virus of Asian influenza. During the period between October and January, seven of the women in our sample displayed a distinct rise in titer of antibodies to this virus. Seven others had elevated titers of antibodies to this virus at the time when their first serum sample was obtained. These elevated titers later fell, suggesting that they also had had recent experiences with this virus.

At the time when the viral infection evidently occurred, some of the women in our sample had displayed typical signs and symptoms of the common cold, others had a typical acute gastroenteritis, others had a typical acute influenza, and others had few or no symptoms or signs of florid illness.

Most of the women who had florid illnesses had had distinctly more such illnesses during the previous five years and also displayed a distinctly greater number of illnesses of this kind during the period when we were observing them. Furthermore, the type of illness that each woman displayed, when infected, tended to be like that which she had customarily displayed in the past. Women who had had gastroenteritis, for example, were those with more recorded episodes of gastroenteritis in the past.

This evidence suggested that a woman's characteristics influenced the nature and the severity of the symptoms and signs of illness that she might display when infected with a viral agent. That this difference in responsiveness was not limited to infectious agents was suggested by the fact that those who had had more episodes of florid respiratory infection were also those who had been more often treated for allergic rhinitis in the past. As a group, they had more engorged nasal mucosae, with more secretion, more of the time during the six months, whether or not they had a florid respiratory illness, and they tended to react more vigorously and more frequently to changes in their temperature.

In addition to this evidence suggesting a difference from woman to woman in susceptibility to florid illness, there was other evidence which suggested that the susceptibility of the individual women changed from time to time. For example, the peak periods of the respiratory epidemics coincided with the coldest, rawest weather of the winter. This may well have been a coincidence. It has been amply demonstrated that chilling of the body will not necessarily increase susceptibility to colds, and, in any case, none of these women were ever out-of-doors enough to become chilled. In spite of this, there was a significant relation between their nasal function and the temperature of the outside air. The rooms in which they worked were kept at a mean temperature of 73° F and a mean humidity of 50 per cent. When the outside air was cold, women coming in from it often experienced a brief period of nasal engorgement and secretion. The number of these brief upper respiratory reactions increased significantly as the weather became colder. The correlation between nasal function, in all the women, and the temperature of the outside air was significantly high when measured by this indicator.

There was, surprisingly, no correlation between nasal function and the

various measures of air pollution, but the explanation for this may lie in the daily round of life of the women. Most of them lived in relatively outlying areas, and few were outdoors for any length of time. They rode to work on subways and buses and went out in the air long enough to chill their nasal mucosae, but apparently not long enough to irritate them with inhalents.

We could not find that the menstrual cycles of these women had any significant influence on the number of their respiratory illnesses, but we did find a most significant relationship between their moods and activities and respiratory involvement. Events which precipitated prolonged periods of tearfulness and crying were significantly associated with subsequent occurrences of pronounced respiratory illness. On a number of occasions, periods of nasal engorgement and increased secretion were observed to occur in association with events such as separation from a child or the illness of a parent; such periods might precede the occurrence of a florid respiratory illness by several days or by more than a week. Supporting this was the evidence from psychological tests, which suggested that women who had many respiratory illnesses were, in general, sadder than those who did not. It was also found that periods of hyperactivity were likely to precede the occurrence of florid respiratory illnesses, and this, too, was supported by the findings on psychological tests, although its meaning, in terms of the mechanism of illness, was not apparent.

In summary, we found that these women, living in close association with many viral agents capable of causing acute respiratory illnesses, were more likely to develop florid illnesses under certain definable environmental conditions. One of these conditions seemed to have to do with the state of her nasal mucosa: if, for some reason, a woman developed an engorged and hypersecreting nose, it seemed to increase the likelihood that she would go on to have a florid illness. There might be various reasons for her nose becoming engorged, such as exposure to changing air temperatures, an argument with a boyfriend, the death of a parent, or a period of hyperactivity and excitement. The reaction of the subject to the environment seemed to be a combination of her reaction to all facets of the environment: the events and situations that surrounded her, the viral agents that she encountered, and the air that she breathed.

Evidence such as this suggests that man's relation to his personal environment may be a most important determinant of his health. Organic reaction patterns, like those nasal reactions that we have just described, seem to be able to influence the function of the great majority of organ systems to a significant degree.

Many of the minor and symptomatic disorders of bodily function which make up the most common forms of illness apparently represent the effects of the prolonged or excessive occurrence of such adaptive reactions. The majority of headaches, the muscular pains, the gastrointestinal disturbances, and the minor respiratory illnesses may fall into this category; but, such minor symptomatic disturbances are a small part of the problem. The evidence from a long-term investigation of people in their usual environments indicates that serious life-endangering illness is likely to occur during periods when many minor functional disturbances are also present, and that these disturbances of bodily function often occur when people are disturbed in relation to their ecological niches.[7-11] Furthermore, those who fit most comfortably into given niches, who by background, temperament, and physical characteristics seem best suited to the situation in life in which they find themselves, seem to do better in terms

of their over-all health. It appears that the adaptive demands upon them are less great than upon others whose characteristics fit less readily the situations in which they must live.

All this suggests that in the future the physician will expend a great deal more effort than heretofore in ascertaining how much of a man's illness is an outgrowth of his interaction with his own personal environment, and what can be done, from a therapeutic point of view, to change this interaction so that the man will be made healthier. I expect that this will be a more difficult challenge than it might at first seem. Each human being is a part of many intermeshing systems, and a disturbance of one part usually disturbs the others. Furthermore, each man helps create his own personal environment and reacts to it as he perceives it—if I may use the word "perceive" to include all those biologic processes which involve the reception and evaluation of information. Also, illness may be an outgrowth of some socially valued behavior. Just as a soldier is supposed to die if necessary to complete his mission, so the businessman, and his family, may value his success more than his health.

One can foresee that the physician of the future will have to be, in human terms, both broader and wiser than the physician of today. The medication and the surgical operation may still be among his most important therapeutic tools, but I expect that he will rely less upon them than upon his understanding of the patient with whom he works and the environment in which that patient lives. This will require of the physician not simply a broader and more general understanding of human nature, but also a more specific and concrete body of factual information about the nature of human society and the determinants of human behavior, the characteristics of the processes of communication and the handling of information within biologic systems, as well as the physical and chemical configurations of the world in which he lives.

REFERENCES

1. Wolff, H. G. Protective Reaction Patterns and Disease. Ann. Int. Med. 27:944, 1947.
2. Hinkle, L. E., Jr., and Wolff, H. G. The Study of Stress, Metabolism, Immune Mechanisms and Susceptibility to Illness. Final Report for Army Contract DA-49-007-MD-524 (Sept. 30), 1962.
3. Holmes, T. H.; Goodell, H.; Wolf, S.; and Wolff, H. G. The Nose. Springfield, Ill.: Thomas, 1950.
4. Hinkle, L. E., Jr.; Christenson, W. N.; Benjamin, B.; Kane, F. D.; Plummer, N.; and Wolff, H. G. The Role of Nasal Adaptive Reactions in the Genesis of Minor Respiratory Illnesses. Presented before the American Psychosomatic Society, Spring Meeting, 1962.
5. Christenson, W. N., and Hinkle, L. E., Jr. An Outbreak of Asian Influenza in a Closely Observed Group of Women: Factors Apparently Influencing the Clinical Manifestations of Illness. Presented before the American Thoracic Society, Spring Meeting, 1963.
6. Jackson, G. G.; Dowling, H. F.; Anderson, T. O.; Riff, L.; Saporta, J.; and Turck, M. Susceptibility and Immunity to Common Upper Respiratory Viral Infections—The Common Cold. Ann. Int. Med. 53:719, 1960.
7. Hinkle, L. E., Jr., and Wolff, H. G. The Nature of Man's Adaptation to His Total Environment and the Relation of This to Illness. A.M.A. Arch. Int. Med. 99:442, 1957.
8. ————. "Health and the Social Environment: Experimental Investigations." In Explorations in Social Psychiatry. Leighton, A. H.; Clausen, J. A.; and Wilson, R. N. (Eds.). New York, N. Y.: Basic Books, 1957.
9. ————. Ecologic Investigations of the Relationship between Illness, Life Experiences and the Social Environment. Ann. Int. Med. 49:1373, 1958.
10. Hinkle, L. E., Jr. Ecological Observations of the Relation of Physical Illness, Mental Illness, and the Social Environment. Psychosom. Med. 23:289, 1961.
11. ————. "Physical Health, Mental Health, and the Social Environment: Some Characteristics of Healthy and Unhealthy People." In Recent Contributions of Biological and Psychological Investigations to Preventive Psychiatry. Ojemann, Ralph H. (Ed.). Iowa City, Iowa: State University of Iowa, 1959.

Dr. Hinkle is director, Human Ecology Study Program, Cornell University Medical College, New York, N. Y.